LUMBER YIELD and LOG VALUES of SHASTA RED FIR

by John B. Grantham

and Douglas L. Hunt

PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION
U. S. DEPT. OF AGRICULTURE · FOREST SERVICE

U. S. FOREST SERVICE
RESEARCH PAPER PNW-2
JULY 1963

SUMMARY

The value of lumber produced from each of 362 Shasta red fir logs of southern Oregon was determined through a cooperative study in 1960.

Lumber grade yield from each log provided the basis for calculating the comparative value of each log grade–log diameter class, in accordance with grading and scaling practices used both east and west of the Cascade Range.

The results, which are summarized graphically in figure 1, should be useful to sellers, buyers, and processors of Shasta red fir logs. The effect on log value of (1) log diameter, (2) log grade, as determined by two systems, and (3) log scaling, as applied in two systems, should be useful in predicting the lumber output and value of the species, providing the variability between individual logs is recognized. The variability in log value is indicated by including scatter diagrams with the grade-yield and value curves for lumber.

Despite the variability that occurs between individual logs, the results of this study should provide a measure of the expected value spread between log grades and log diameter classes. Refinements in log grading systems, changes in scaling practices, or changes in utilization standards will alter the comparative values developed in this study. As an initial analysis, however, this study provides a basis to evaluate product-yield data that may be developed in future studies of Shasta red fir. For example, a firm could find it helpful to compare its lumber output from a given mix of log grades and sizes with the yield that would be predicted from results of this study.

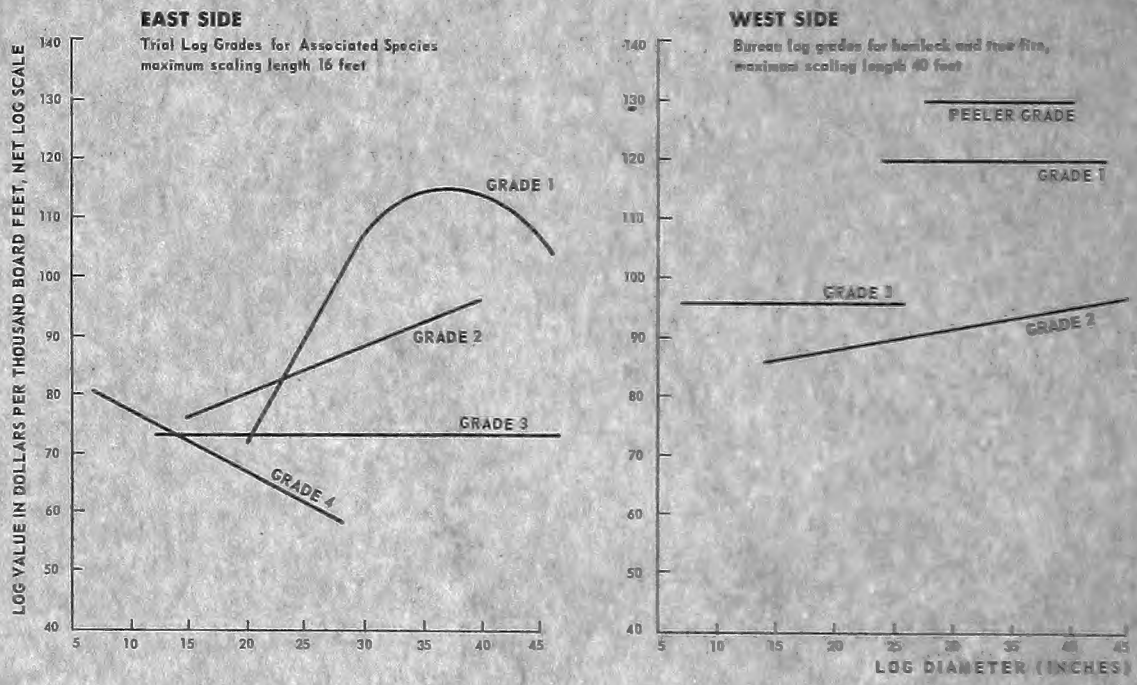

Figure 1.--Comparative log values for Shasta red fir of southern Oregon when graded and scaled in accordance with east-side and west-side practices.

U.S. FOREST SERVICE
Research Paper PNW-2

LUMBER YIELD AND LOG VALUES OF SHASTA RED FIR

By

John B. Grantham and Douglas L. Hunt

July 1963

PACIFIC NORTHWEST
FOREST AND RANGE EXPERIMENT STATION
Philip A. Briegleb, Director Portland, Oregon

FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

CONTENTS

INTRODUCTION

As logging operations have extended into the upper-slope forest types of the southern Cascades and Siskiyou Mountains, interest has increased in the lumber grade yield from the true firs encountered there. As a result, two cooperative studies of lumber grade yield from the true firs of southern Oregon were made in 1960 and 1961. Lumber grade yield from Shasta red fir, studied at Prospect, Oreg., in December 1960,[1/] is reported here and refers to either Shasta red fir or California red fir growing in Oregon.[2/]

Since it is difficult to distinguish Shasta red fir from California red fir, it has been the industry practice to refer to both as Shasta red fir where they occur in Oregon. This report of lumber grade yield from Shasta red fir is applicable to either Shasta or California red fir growing in southern Oregon, since the log sample was drawn from three sale areas on the Rogue River National Forest in Jackson County, Oreg., without distinguishing between the species and its variety.

PROCEDURE

Logs were accumulated for 3 months to provide a good range of log grade and log diameter classes available in this part of Oregon. Study logs were then selected from the accumulated deck to give two samples: (1) a sample of 362 logs as bucked in the woods and (2) a sample of 671 logs as sawed in the mill after rebucking. As would be expected, the second sample,

---

[1/] This study was a cooperative project, with Olson Lawyer Lumber, Inc., U.S. Forest Service, Bureau of Land Management, West Coast Lumber Inspection Bureau, and Bureau of Indian Affairs participating.

[2/] The distribution of Shasta red fir (Abies magnifica var. shastensis) is not clearly distinguished from that of California red fir (Abies magnifica), which it resembles closely. Together they grow in upper-slope stands, generally above the white fir belt, from the Cascade Range of southern Oregon to the Sierra Nevada of central California. Both the type species and the variety resemble noble fir in their size and excellent form but are supposedly distinguished from the latter by bark characteristics at maturity. The bark of mature California red and Shasta red fir is reddish brown to black and deeply furrowed; that of mature noble fir is gray black or purplish and broken into shallow plates that give it a checkered appearance.

which after rebucking included almost twice as many logs, gave the better sample distribution by log grade and diameter class.[3/]

Sawing Specifications

The logs selected for this study were sawed at the Olson Lawyer Lumber, Inc., mill in Prospect, Oreg.; the lumber output was kiln-dried and surfaced at the company's plant in White City, Oreg. Manufacturing facilities and sawing practices at the band sawmill were considered representative of industry practice for this and related species. Sawing was done to obtain the maximum amount of 5/4-inch Select and Shop lumber and a maximum quantity of Dimension lumber from the lower quality portion of the logs. Only a small proportion of 1-inch Common boards were produced.

The lumber was graded[4/] in both the rough green and surfaced dry condition under the supervision of an inspector from the West Coast Lumber Inspection Bureau.

Log Diagraming, Grading, and Scaling

In the mill yard the visible surface and end characteristics of each log were recorded on prepared forms so that the relationship of a log's external characteristics to its lumber grade yield could be restudied in detail for purposes of tree grade development or log grade refinement.

Study logs were graded and scaled in accordance with practices in use on both the west side and east side of the Cascade Range. West-side official Bureau log grades[5/] were assigned in the yard by the U.S. Forest Service

---

[3/] Since study logs are selected with the objective of providing a representative number of logs in each grade and diameter class, any sample drawn does not represent the log mix available to a given mill. Thus, lumber grade-yield and overrun data, developed in a study, must be weighted by the relative proportions of each log grade and diameter class available to a mill in order to estimate the lumber yield of that mill.

[4/] Grading of Shop lumber, including Molding stock, was in accordance with Standard Grading Rules (1960) of the Western Pine Association, Portland, Oreg.; grading of Selects, Dimension, and Common boards was in accordance with Standard Grading and Dressing Rules, Number 15, for Sitka spruce (revised February 18, 1960) of the West Coast Lumber Inspection Bureau, Portland, Oreg.

[5/] Page 27 of Official Log Scaling and Grading Rules for the Puget Sound, Grays Harbor, Southern Oregon and Northern California Log Scaling and Grading Bureaus. Tacoma, Wash. March 1, 1962.

representative in charge of grading and scaling for the western regions. He also scaled the logs in the yard before bucking (maximum scaling length 40 feet) in accordance with Bureau scaling practices.

Grading by Trial Log Grades for Associated Species (east-side practice)[6/] was done in the mill yard by the same Forest Service representative after logs over 20 feet long were marked for bucking into two pieces. The east-side scale (maximum scaling length 16 feet) was not made, however, until the logs had been bucked on the sawmill deck. This procedure allowed adequate time for careful grading in the yard and still permitted observation of all log ends before they were scaled.

To clarify the application of these procedures, a 22-inch, 36-foot log is used as an example. The log was first graded and scaled in the yard, in accordance with west-side practice, as a grade 2 Sawmill log (Bureau grade) having a gross and net scale of 750 board feet. Next, the log was marked for bucking and graded (in accordance with east-side practice) as a 16-foot grade 2 log (butt) and a 20-foot grade 2 log (top).

When this log entered the sawmill, it was bucked where marked and the sections assigned the next consecutive sawing numbers. Since the maximum scaling length (east-side practice) was 16 feet, the 20-foot top section was scaled as two 10-foot logs. Thus, the gross scale of this log by east-side practice was a combination of two 10-foot logs and a 16-foot butt section which totaled 820 board feet. When the log was bucked on the deck, it appeared sound and both sections were given full scale. In manufacture, the butt section produced 429 board feet of surfaced dry lumber and the top section 487 board feet. Thus, the overruns were 11.7 percent by east-side practice (scaled as three sections) and 22.1 percent by west-side practice (scaled as one log).

The study logs had a net scale of 206,760 and 177,770 board feet when scaled by east-side and west-side practice, respectively. The output of surfaced dry lumber was 232,002 board feet. The east-side scale, made on the sawmill deck after logs were bucked for sawing, gave a total deduction for defect of 24,580 board feet. By comparison, the defect deduction in west-side scaling was 26,020 board feet. Thus, the pronounced difference in net log scale was due almost entirely to the difference in scaling length.

Sawing

Once such pertinent information was recorded for the test logs, they were fed to the saw and cut according to previously agreed-on practice. In

---

[6/] See page 1 in the appendix.

brief, the company sought the highest value obtainable from each log regardless of the order file, sawing Select and Shop lumber (in 4/4- and 5/4-inch thicknesses) from the outer portion of the log and 2-inch Dimension from the balance.

Each piece of lumber produced from a given log was color coded to maintain its identity until the sawing number of the log could be written on the face of the board. As lumber reached the green sorting chain, each piece was tallied by its rough green dimensions, grade, and log number.

Sawing accuracy at the mill, based on about 150 measurements of each lumber thickness, was generally good. It was best on 2-inch Dimension where more than 90 percent of the pieces measured were 29/16 plus or minus 1/16 inch. More than 85 percent of the 5/4-inch lumber measured 23/16 plus or minus 1/16 inch. One-inch lumber was less uniform in thickness, averaging 18/16 inches but varying plus or minus 2/16 from the average. However, 1-inch lumber represented only 5 percent of the output.

Kiln-Drying

When sawing was complete, the loads of study lumber were trucked some 40 miles to the company's drying and planing facilities at White City. Company kilns were end-loading, cross-circulating, steam-heated, internal-fan kilns of modern design and in good operating condition. The test lumber, after hand stacking, was dried on the company's usual production schedules. Select and Shop grades were dried to an average moisture content of 8 percent. The company, which produces in an arid part of Oregon and ships a substantial part of its output to arid regions, dried the Dimension test lumber to an average moisture content of 9 percent. A species such as Shasta red fir is expected to tolerate this drying, to a lower than industry average moisture content level, better than a denser species such as Douglas-fir, and there was no evidence of undue degrade in the form of checks, warp, or broken knots.

Surfacing

Following drying, the lumber was dry-sorted by planing item (dimensions) and by the original green chain grademark. Thus, when one lot of test lumber (such as 2 by 8 Construction) was surfaced, graded, and tallied, the surfaced dry grade yield could be compared with the green grade input. Grading behind the planer was done by certified company graders under the supervision of the same WCLIB inspector who had graded the stock on the green chain.

The surfaced dry lumber output provided the basis for all grade-yield data reported herein, but in order to reveal the surfaced dry yield from an individual log, it was necessary to establish green-to-dry conversion factors. This was done by summarizing the change that occurred in each green grade

for each planing item and computing a weighted-average, surfaced dry output for each green grade input. The rough green grade yield of each individual log was then converted to a surfaced dry yield by means of these conversion factors.

Analysis of Data

In order to provide for the sale of Shasta red fir timber of southern Oregon, and its subsequent conversion to lumber by either east- or west-side practice, the lumber grade-yield data derived in this study have been analyzed in two ways.

First, lumber grade recovery from the 671 logs sawed was analyzed and summarized. These logs, which varied in length from 12 to 20 feet, were graded in accordance with the Trial Log Grades for Associated Species and scaled in accordance with Forest Service scaling practice then in effect for eastern Oregon—logs over 16 feet in length being scaled as two logs.

Second, the lumber grade yield from the original 362 study logs was obtained by combining the lumber recovery from the two sections of each long log. In this case, each of the 362 logs (ranging from 12 to 40 feet in length) was graded by west-side Bureau grading system and scaled as one log in accordance with Bureau practice for west-side operations.

In analyzing lumber yields and log values for both east- and west-side grading and scaling practices the following procedures were used:

1. Within each log grade (trial grade or Bureau grade) the logs in each 1-inch diameter interval were combined to form a log group. The yield of surfaced dry lumber (by lumber grade) from a log group provided the basic data for computing log values. This information also provided the basis for the lumber grade recovery tables that are included in the appendix.

2. The volume of surfaced dry lumber in each lumber grade was multiplied by the appropriate 1960 price (listed in the appendix) to compute the total value (in dollars) of the lumber yield from each log group.

3. The total value of lumber from each log group was divided by its total volume of surfaced dry lumber to give unit lumber value for the log group. This unit lumber value—expressed in dollars per thousand board feet, lumber tally—is a convenient index of lumber grade yield and is useful in comparing the quality of lumber produced from various grades and/or sizes of logs.

4. The total value of lumber from each log group was divided by its total net log scale to give the unit log value of the group. The unit log value—expressed in dollars per thousand board feet, net log

scale—is the most meaningful value derived, since it reflects not only the quality but the quantity of lumber recovered from a given log group and provides the yardstick for buying and selling timber or logs.

RESULTS AND DISCUSSION—EAST-SIDE PRACTICE

Lumber Recovery Based on Trial Log Grades for Associated Species and a 16-Foot Maximum Scaling Length

Distribution of the 671 logs is shown by log grade and diameter class in table 1. The log sample was well distributed by log grade and by diameter classes except for large diameter logs that are always difficult to obtain in the desired number.

The log volume, lumber volume, and lumber value for the logs in each 1-inch diameter interval within each log grade are shown in table 2. This digest of findings not only provides the basis for most subsequent discussion but permits further analysis of results by those who may be interested.

Lumber Grade Yield by Log Grade–Diameter Class

In order that the influence of log quality and log size on lumber yield may be visualized more readily, the bulk of the study logs has been grouped further into 6-inch diameter intervals. All pertinent data for each of the 6-inch diameter intervals have been summarized in table 3. Any 6-inch diameter interval containing less than 10 logs was omitted from the summary table.

Although much of the variability that occurs in lumber yield is smoothed by grouping logs into 6-inch diameter intervals, such grouping still provides an accurate generalization of lumber grade yield. To illustrate this fact, the yield of each lumber grade from grade 3 logs has been plotted by 1-inch diameter intervals in figure 2. Grade yields for the 6-inch diameter intervals of table 3, if plotted on figure 2, will fit the scatter diagrams rather well.

Lumber Value as an Index of Lumber Grade Yield

Lumber value, expressed in dollars per thousand board feet, lumber tally, provides a convenient index to lumber grade yield and facilitates comparison of the lumber quality obtained from logs of varying quality and size. Thus, the overall effect of log grade and diameter on lumber grade yield can be judged readily by referring to figure 3.

Log Value by Log Grade–Diameter Class

Log value, expressed in dollars per thousand board feet, net log scale, is the most meaningful measure of product yield. Since logs generally are purchased on the basis of net log scale, it is important to know the comparative

Table 1.--Distribution of 671 Shasta red fir short logs, by diameter class and log grade, southern Oregon study, 1960

Diameter class (inches)	Log grades[1/]				
	No. 1	No. 2	No. 3	No. 4	Total
6- 8	--	--	--	10	10
9-11	--	--	--	76	76
12-14	--	--	88	11	99
15-17	--	7	92	10	109
18-20	3	12	81	8	104
21-23	13	20	40	6	79
24-26	12	9	30	2	53
27-29	16	13	18	1	48
30-32	15	8	11	--	34
33-35	13	4	9	--	26
36-38	11	4	3	--	18
39-41	9	1	--	--	10
42-44	2	--	--	--	2
45-47	1	--	1	--	2
48-50	--	--	1	--	1
Total	95	78	374	124	671

1/ Trial Log Grades for Associated Species.

NOTE: The heavy lines enclose those log grade—diameter classes that are included in table 3. Data from all logs are summarized in tables 8-11 of the appendix.

Table 2.--Net log scale, total lumber volume, and total lumber value for Shasta red fir, by diameter and log grade, southern Oregon study, 1960

Log diameter (inches)	Log grade 1/											
	No. 1			No. 2			No. 3			No. 4		
	Net log scale	Lumber tally	Lumber value	Net log scale	Lumber tally	Lumber value	Net log scale	Lumber tally	Lumber value	Net log scale	Lumber tally	Lumber value
	--- Bd. ft. ---		Dollars	--- Bd. ft. ---		Dollars	--- Bd. ft. ---		Dollars	--- Bd. ft. ---		Dollars
7	--	--	--	--	--	--	--	--	--	90	96	5.17
8	--	--	--	--	--	--	--	--	--	200	327	17.49
9	--	--	--	--	--	--	--	--	--	780	1,097	61.40
10	--	--	--	--	--	--	--	--	--	1,530	2,146	120.68
11	--	--	--	--	--	--	--	--	--	2,290	2,951	166.13
6-11	--	--	--	--	--	--	--	--	--	4,890	6,617	370.87
12	--	--	--	--	--	--	1,960	2,802	167.57	390	536	28.58
13	--	--	--	--	--	--	3,920	4,781	275.54	290	420	22.09
14	--	--	--	--	--	--	3,420	3,912	223.28	380	575	30.77
15	--	--	--	230	214	13.99	4,870	5,981	348.36	360	458	24.26
16	--	--	--	520	516	40.43	5,130	6,571	385.93	600	820	45.99
17	--	--	--	270	360	23.27	5,510	6,573	399.88	540	510	25.94
12-17	--	--	--	1,020	1,090	77.69	24,810	30,620	1,800.56	2,560	3,319	177.63
18	--	--	--	1,330	1,340	100.66	6,460	7,750	461.41	910	1,221	67.10
19	210	111	9.04	1,300	1,481	99.76	8,120	9,310	578.35	340	354	19.54
20	380	389	24.75	280	217	21.93	6,460	6,832	435.47	490	523	32.89
21	880	810	79.27	4,030	4,573	335.65	4,650	5,211	329.92	820	1,017	58.45
22	2,030	2,001	159.01	1,730	1,682	142.81	5,380	6,173	387.49	850	814	47.89
23	1,400	1,349	124.83	830	932	65.82	3,580	3,338	235.84	230	285	17.46
18-23	4,900	4,660	396.90	9,500	10,225	766.63	34,650	38,614	2,428.48	3,640	4,214	243.33
24	1,400	1,488	124.46	500	560	41.70	4,150	5,246	366.27	350	336	17.70
25	870	942	86.58	1,850	2,111	151.32	3,360	3,426	221.47	--	--	--
26	2,610	2,800	267.96	1,570	1,573	118.68	4,680	5,044	357.86	220	246	14.30
27	2,690	2,901	233.06	610	520	49.52	3,990	4,223	282.69	--	--	--
28	4,130	4,338	430.75	5,640	6,095	493.57	3,770	3,699	281.24	540	529	33.60
29	2,040	2,342	229.68	1,390	1,469	128.58	2,340	2,359	176.41	--	--	--
24-29	13,740	14,811	1,372.49	11,560	12,328	983.37	22,290	23,997	1,685.94	1,110	1,111	65.60
30	1,800	2,118	184.74	2,000	1,975	190.93	1,760	2,051	138.60	--	--	--
31	3,260	3,376	343.06	3,320	3,612	298.23	3,500	3,768	278.70	--	--	--
32	4,520	4,992	524.17	--	--	--	1,690	1,847	113.45	--	--	--
33	2,380	2,413	225.46	1,630	1,755	166.20	2,440	2,647	180.49	--	--	--
34	3,390	4,085	401.53	--	--	--	720	733	72.06	--	--	--
35	3,690	4,117	417.95	1,620	1,821	154.90	4,130	4,658	377.91	--	--	--
30-35	19,040	21,101	2,096.91	8,570	9,163	810.26	14,240	15,704	1,161.21	--	--	--
36	1,570	2,221	194.41	--	--	--	1,740	1,809	135.12	--	--	--
37	3,510	3,876	376.81	3,270	3,297	278.32	770	853	53.41	--	--	--
38	3,360	3,883	403.26	890	1,015	70.34	--	--	--	--	--	--
39	3,390	3,852	369.04	--	--	--	--	--	--	--	--	--
40	4,630	5,028	484.69	940	1,031	85.87	--	--	--	--	--	--
41	760	1,090	118.99	--	--	--	--	--	--	--	--	--
36-41	17,220	19,950	1,947.20	5,100	5,343	434.53	2,510	2,662	188.53	--	--	--
43	2,310	2,546	269.31	--	--	--	760	940	80.03	--	--	--
46	1,260	1,497	122.95	--	--	--	--	--	--	--	--	--
48	--	--	--	--	--	--	1,080	1,490	76.74	--	--	--

1/ Trial Log Grades for Associated Species.

Table 3.--Log input, lumber yield, and lumber value for Shasta red fir of southern Oregon, based on east-side log grading and scaling practices[1/]

LOG INPUT AND LUMBER YIELD

Item	Log grade and diameter class													
	No. 1 Sawmill				No. 2 Sawmill			No. 3 Sawmill				No. 4 Sawmill		
	18-23	24-29	30-35	36-41	18-23	24-29	30-35	12-17	18-23	24-29	30-35	6-11	12-17	18-23
Logs.....number..	16	28	28	20	32	22	12	180	121	48	20	86	21	14
Gross log scale...board feet..	5,630	16,070	21,970	22,020	9,790	12,950	9,580	25,540	35,750	25,580	15,760	5,060	2,650	3,840
Net log scale.....board feet..	4,900	13,740	19,040	17,220	9,500	11,560	8,570	24,810	34,650	22,290	14,240	4,890	2,560	3,640
Defect.....percent..	13	14	13	22	3	11	11	3	3	13	10	3	3	5
Lumber tally.....board feet..	4,659	14,812	21,100	19,951	10,225	12,328	9,163	30,619	38,613	23,996	15,704	6,617	3,320	4,214
Overrun.....percent..	-5	8	11	16	8	7	7	23	11	8	10	35	30	16
GRADE YIELD (in percent)														
Dry lumber grades:														
Select:														
C	10	12	14	14	7	6	12	1	2	3	4	1	0	1
D	6	5	5	5	4	3	3	1	1	3	2	0	0	0
Total	16	17	19	19	11	9	15	2	3	6	6	1	0	1
Shop:														
Molding	20	27	32	29	13	20	23	3	6	12	15	2	1	2
All Shop and Outs	21	19	20	21	11	21	21	3	13	26	28	2	2	29
Total	41	46	52	50	24	41	44	6	19	38	43	4	3	31
Common:														
Standard and Better	14	14	11	13	31	22	17	50	41	24	22	49	46	30
Utility	14	11	9	9	19	15	12	25	21	16	15	28	31	21
Economy	15	12	9	9	15	13	12	17	16	16	14	18	20	17
Total	43	37	29	31	65	50	41	92	78	56	51	95	97	68
LUMBER VALUE (in dollars)														
Basis:														
Per M b.m. lumber tally	85.19	92.66	99.38	97.60	74.98	79.77	88.43	58.81	62.89	70.26	73.94	56.05	53.50	57.74
Per M b.m. net log scale	81.00	99.89	110.13	113.08	80.70	85.07	94.55	72.57	70.09	75.64	81.55	75.84	69.39	66.85

[1/] Trial Log Grades for Associated Species; maximum scaling length, 16 feet.

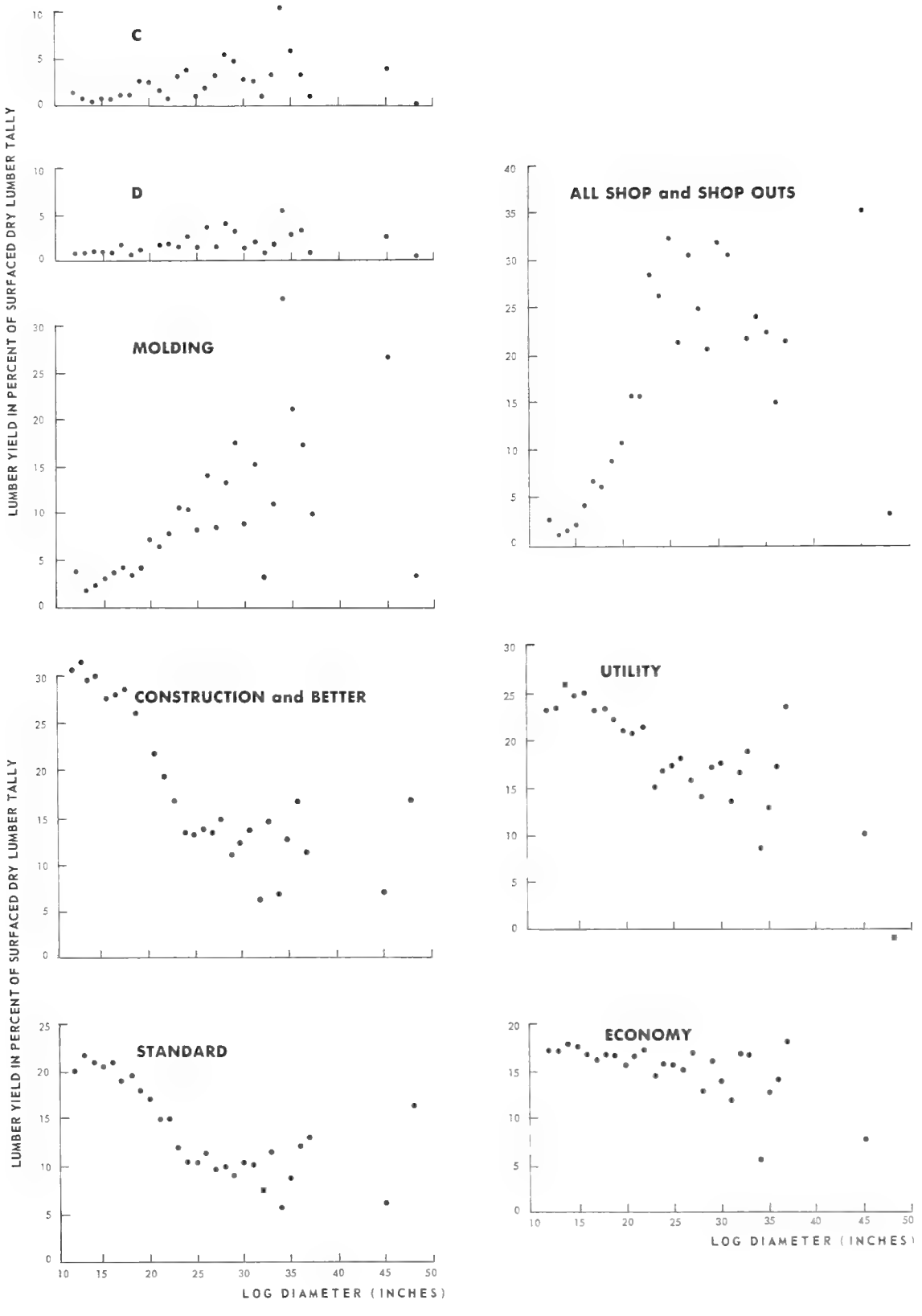

Figure 2.--Lumber grade yield by log diameter for grade 3 logs (Trial Log Grades for Associated Species).

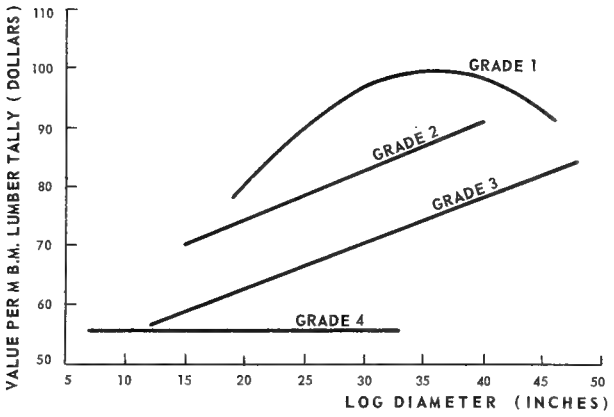

Figure 3.--Relationship of dollars per thousand board feet, dry lumber tally basis, to log diameter by log grade (Trial Log Grades for Associated Species).

value (in dollars per thousand board feet, net log scale) of lumber obtained from logs of varying grade and diameter. The values of Shasta red fir logs are shown separately by 1-inch diameter intervals for each log grade (Trial Log Grades for Associated Species) in figure 4.

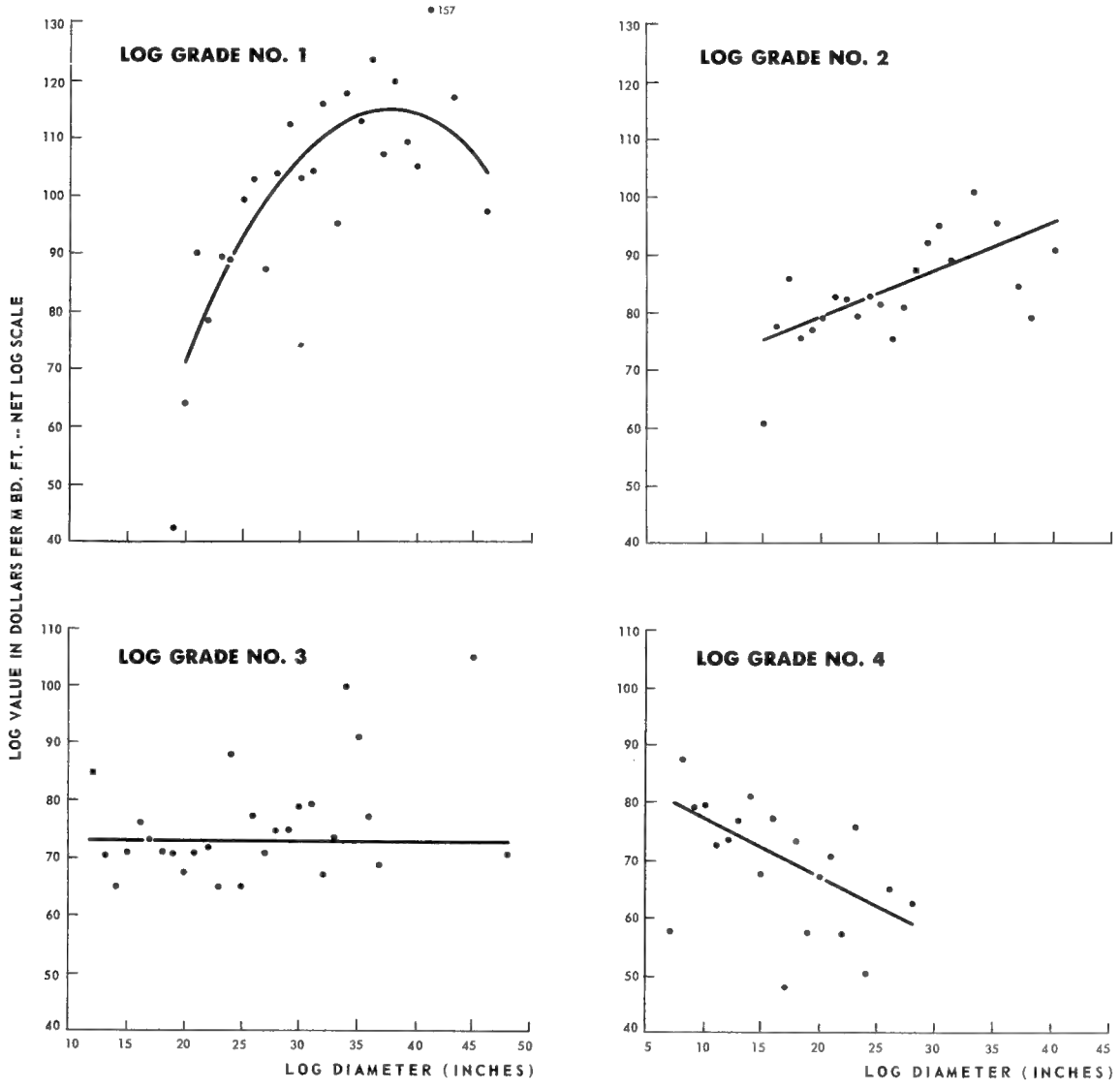

Figure 4.--Relationship of log value (dollars per thousand board feet, net log scale) to diameter by log grade (Trial Log Grades for Associated Species).

Comparison of the curves in figure 4 with those shown in figure 3 reveals that the log value curves generally are higher and of somewhat different slope than the lumber value curves. This is because the log values are influenced by overrun. For example, the lumber value curve for log grade 3 runs from a $57 value for a 12-inch log to an $82 value for a 45-inch log. By comparison, the log value curve for log grade 3 shows a constant value of about $73 for all log diameters—the value differences in table 3 being insignificant. The higher overrun (or greater spread between lumber volume output and net log scale input) developed in small diameter logs has thus offset the somewhat lower value of lumber from small logs.

Variation in Overrun

Since overrun is automatically considered in determining the log value of each log grade-diameter class, no general overrun curve is included in the report. Trends in overrun by log diameter are evident from the data presented in tables 2 and 3, but considering the variation one should be cautious in generalizing from these data. For example, on first perusal of table 3 the reader may observe a different trend in overrun for each log grade, but this is due in part to the arrangement of the table. If the overruns shown for the 6-inch diameter intervals are arranged for easier comparison, as in table 4, the differences in overrun by log grade are not too marked.

Table 4.--Overrun by log grade and log diameter in percent of dry surfaced lumber

Log grade	Log diameter class (in inches)					
	6-11	12-17	18-23	24-29	30-35	36-41
1	--	--	-5	8	11	16
2	--	--	8	7	7	--
3	--	23	11	8	10	--
4	35	30	16	--	--	--

Relationship of Scaled Defect to Log Diameter

Scaled deductions for defect increased with an increase in log diameter in each log grade as is indicated in table 3. The relationship of scaled defect to log diameter is shown for all log grades combined in figure 5 where defect ranged from 2 percent in the smallest logs to 22 percent in 40-inch logs.

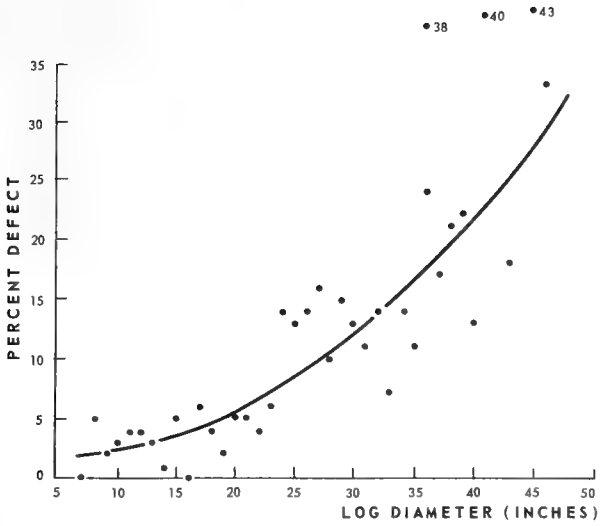

Figure 5.--Relationship of scaled defect percent to log diameter; all log grades combined (Trial Log Grades for Associated Species).

RESULTS AND DISCUSSION—WEST-SIDE PRACTICE

Lumber Recovery Based on Bureau Log Grades and a 40-Foot Maximum Scaling Length

Distribution of the 362 logs, as graded and scaled in accordance with west-side practice, is shown in table 5. The log volume, lumber volume, and lumber value of the logs in each 1-inch diameter interval within each log grade are shown in table 6. This digest of study data not only provides the basis for most subsequent discussion but permits a further analysis of results by those who may be interested.

Lumber Grade Yield by Log Grade-Diameter Class

In order that the influence of log quality and log size on lumber yield may be visualized more readily, the bulk of the logs included in the study has been grouped further into 6-inch diameter intervals. All pertinent log input and lumber output data for each of the 6-inch diameter intervals have been summarized in table 7. Those 6-inch diameter intervals containing less than 10 logs were omitted from the summary table.

Although much of the variability that occurs in lumber yield is smoothed by grouping logs into 6-inch diameter intervals, this grouping still provides an accurate generalization of lumber grade yield. To illustrate this fact, the yield of the common lumber grades from grade 2 logs has been plotted by 1-inch diameter intervals in figure 6. Grade yields for the 6-inch diameter intervals of table 7, if plotted at the midpoint of the diameter class on figure 6, will fit the scatter diagrams rather well.

Lumber Value as an Index of Lumber Grade Yield

Lumber value (expressed in dollars per thousand board feet, lumber tally) provides a convenient index to lumber grade yield and facilitates

Table 5.--Distribution of 362 Shasta red fir long logs, by diameter class and log grade, southern Oregon study, 1960

Diameter class (inches)	Log grades[1/]				
	Peeler	No. 1	No. 2	No. 3	Total
6- 8	--	--	--	12	12
9-11	--	--	--	52	52
12-14	--	--	18	42	60
15-17	--	--	50	7	57
18-20	--	--	50	9	59
21-23	--	--	27	4	31
24-26	--	7	19	1	27
27-29	2	8	12	--	22
30-32	3	5	9	--	17
33-35	1	5	4	--	10
36-38	1	4	4	--	9
39-41	2	1	0	--	3
42-44	--	1	0	--	1
45-47	--	--	1	--	1
48-50	--	--	1	--	1
Total	9	31	195	127	362

[1/] Official Log Scaling and Grading Rules for the Puget Sound, Grays Harbor, Southern Oregon, Northern California, and Tillamook County Log Scaling and Grading Bureaus.

NOTE: The heavy lines enclose those log grade-diameter classes that are included in table 7. Data from all logs are summarized in tables 12-15 of the appendix.

Table 6.--Net log scale, total lumber volume, and total lumber value for Shasta red fir, by diameter and log grade, southern Oregon study, 1960

Log diameter (inches)	Log grade 1/											
	Peeler			No. 1 Sawmill			No. 2 Sawmill			No. 3 Sawmill		
	Net log scale	Lumber tally	Lumber value	Net log scale	Lumber tally	Lumber value	Net log scale	Lumber tally	Lumber value	Net log scale	Lumber tally	Lumber value
	--- Bd. ft. ---		Dollars	--- Bd. ft. ---		Dollars	--- Bd. ft. ---		Dollars	--- Bd. ft. ---		Dollars
7	--	--	--	--	--	--	--	--	--	240	378	19.83
8	--	--	--	--	--	--	--	--	--	420	818	46.25
9	--	--	--	--	--	--	--	--	--	1,540	2,795	159.32
10	--	--	--	--	--	--	--	--	--	1,840	3,013	169.38
11	--	--	--	--	--	--	--	--	--	1,990	3,318	188.52
6-11	--	--	--	--	--	--	--	--	--	6,030	10,322	583.30
12	--	--	--	--	--	--	--	--	--	2,160	3,686	212.80
13	--	--	--	--	--	--	--	--	--	4,500	7,650	439.38
14	--	--	--	--	--	--	3,980	5,818	339.00	260	534	31.58
15	--	--	--	--	--	--	4,560	6,292	387.81	790	1,456	81.34
16	--	--	--	--	--	--	5,430	7,458	475.93	--	--	--
17	--	--	--	--	--	--	5,450	7,355	466.34	620	839	43.16
12-17	--	--	--	--	--	--	19,420	26,923	1,669.08	8,330	14,165	808.26
18	--	--	--	--	--	--	8,390	11,640	737.45	1,200	1,603	87.52
19	--	--	--	--	--	--	7,650	10,281	683.50	1,050	1,896	101.60
20	--	--	--	--	--	--	6,980	8,569	610.44	560	698	47.27
21	--	--	--	--	--	--	6,560	7,761	601.91	380	512	32.08
22	--	--	--	--	--	--	6,170	7,526	523.28	940	1,355	67.57
23	--	--	--	--	--	--	4,370	5,313	405.42	420	844	57.21
18-23	--	--	--	--	--	--	40,120	51,090	3,562.00	4,550	6,908	393.25
24	--	--	--	1,480	1,784	155.03	4,490	5,595	381.17	--	--	--
25	--	--	--	1,660	2,231	212.67	4,110	5,408	389.99	--	--	--
26	--	--	--	2,330	3,033	295.19	5,460	6,606	523.45	370	548	32.01
27	--	--	--	4,160	4,748	400.41	3,520	3,972	278.59	--	--	--
28	1,520	1,792	194.17	3,250	4,371	432.03	5,430	6,420	481.09	--	--	--
29	--	--	--	1,030	1,425	137.38	2,740	3,062	222.60	--	--	--
24-29	1,520	1,792	194.17	13,910	17,592	1,632.71	25,750	31,063	2,276.89	370	548	32.01
30	2,380	2,793	280.09	2,820	3,275	324.89	2,050	2,619	219.65	--	--	--
31	1,310	1,804	189.35	1,290	1,628	158.96	3,900	4,989	376.62	--	--	--
32	--	--	--	1,140	1,674	164.92	5,090	6,648	483.49	--	--	--
33	--	--	--	2,940	3,824	399.62	2,690	3,270	280.20	--	--	--
34	1,300	1,840	203.25	1,160	1,512	160.71	1,570	1,766	162.70	--	--	--
35	--	--	--	2,700	3,496	341.14	1,430	1,622	126.32	--	--	--
30-35	4,990	6,437	672.69	12,050	15,409	1,550.24	16,730	20,914	1,648.98	--	--	--
36	--	--	--	2,180	3,001	251.79	1,730	1,965	149.38	--	--	--
37	1,670	1,894	199.83	3,620	4,070	345.80	3,730	4,545	366.33	--	--	--
38	--	--	--	--	--	--	1,600	2,046	156.21	--	--	--
39	1,960	2,315	245.74	--	--	--	--	--	--	--	--	--
40	2,240	2,730	294.95	--	--	--	--	--	--	--	--	--
41	--	--	--	850	1,090	118.99	--	--	--	--	--	--
43	--	--	--	1,220	1,216	124.78	--	--	--	--	--	--
45	--	--	--	--	--	--	1,900	2,437	202.98	--	--	--
48	--	--	--	--	--	--	1,300	1,490	76.74	--	--	--

1/ Official Log Scaling and Grading Rules for the Puget Sound, Grays Harbor, Southern Oregon, Northern California, and Tillamook County Log Scaling and Grading Bureaus.

Table 7.--Log input, lumber yield, and lumber value for Shasta red fir of southern Oregon, based on west-side log grading and scaling practices[1/]

LOG INPUT AND LUMBER YIELD

Item	Log grade and diameter class								
	No. 1 Sawmill		No. 2 Sawmill				No. 3 Sawmill		
	24-29	30-35	14-17	18-23	24-29	30-35	6-11	12-17	18-23
Logs.....number..	15	10	68	77	31	13	64	49	13
Gross log scale...board feet..	17,070	14,980	20,040	42,790	29,910	19,550	6,300	8,820	5,080
Net log scale.....board feet..	13,910	12,050	19,420	40,120	25,750	16,730	6,030	8,330	4,550
Defect.....percent..	19	20	3	6	14	14	4	6	10
Lumber tally.....board feet..	17,593	15,410	26,923	51,090	31,064	20,915	10,319	14,164	6,949
Overrun.....percent..	26	28	39	27	21	25	71	70	53
GRADE YIELD (in percent)									
Dry lumber grades:									
Select:									
C	11	17	2	4	4	7	1	1	1
D	5	4	1	2	3	3	0	1	1
Total	16	21	3	6	7	10	1	2	2
Shop:									
Molding	28	30	5	11	14	18	2	3	3
All Shop and Outs	21	20	6	15	26	23	1	4	20
Total	49	50	11	26	40	41	3	7	23
Common:									
Standard and Better	15	11	46	33	22	20	51	46	29
Utility	10	9	24	20	16	15	26	26	24
Economy	10	9	16	15	15	14	19	19	22
Total	35	29	86	68	53	49	96	91	75
LUMBER VALUE (in dollars)									
Basis:									
Per M b.m. lumber tally	92.80	100.60	61.99	69.72	73.30	78.84	56.52	57.06	56.60
Per M b.m. net log scale	116.93	128.79	86.17	88.54	88.69	98.55	96.65	97.00	86.60

[1/] Bureau log grades for hemlock; maximum scaling length, 40 feet.

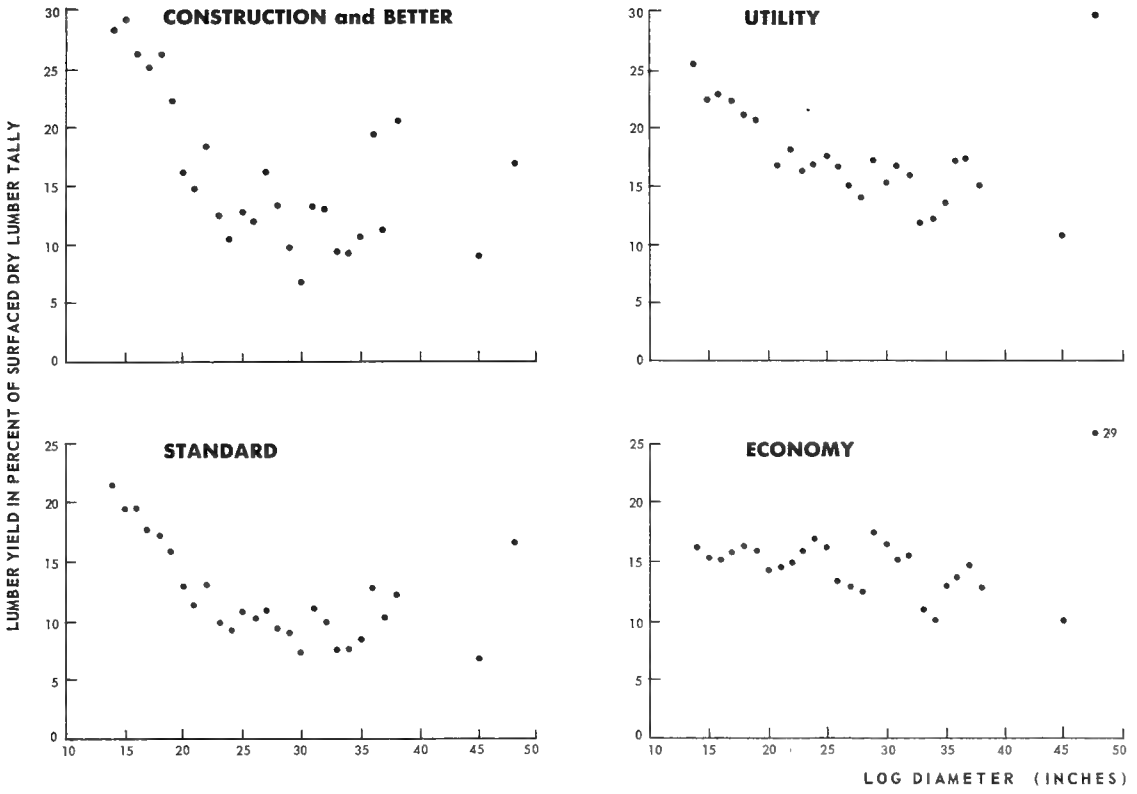

Figure 6.--Common lumber grade yield by log diameter for grade 2 logs (Official Log Scaling and Grading Rules).

comparison of the lumber quality obtained from logs of varying quality and size. Thus, the overall influence of log grade and diameter on lumber grade yield can be judged readily by referring to figure 7.

It is desirable at this point to explain why lumber values plotted over log diameter may give horizontal lines for some log grades, increasing or decreasing straight lines for other log grades, and curved lines for still other log grades. A statistical test of significance was applied to the curved value of each log grade. Only that type of curve that could be statistically defended on the basis of significance was shown. Where the data did not warrant a

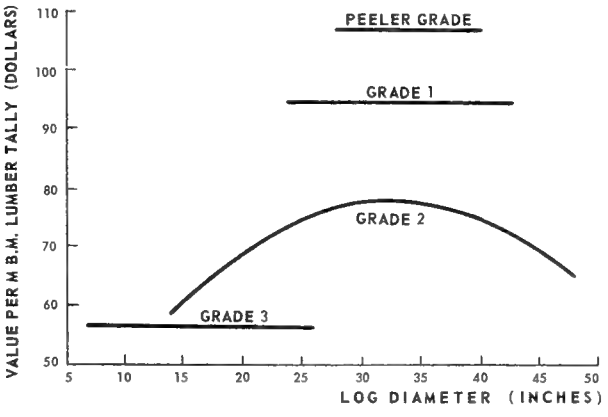

Figure 7.--Relationship of dollars per thousand board feet, dry lumber tally basis, to log diameter by log grade (Official Log Scaling and Grading Rules).

curve (or straight line) of either increasing or decreasing value, the average value for the log grade was shown over all diameters found in the study.

Log Value by Log Grade–Diameter Class

Log value (expressed in dollars per thousand board feet, net log scale) is the most meaningful measure of product yield. Since logs generally are purchased on the basis of net log scale, it is important to know the comparative value (in dollars per thousand board feet, net log scale) of varying grade and diameter. In figure 8 the values of Shasta red fir logs are shown separately by 1-inch diameter intervals for each log grade (Bureau log grades).

Comparison of the curves in figure 8 with those in figure 7 reveals that the log value curves generally are higher and of somewhat different slope than the lumber value curves. This is because the log values are influenced by overrun. In figure 8 the ratios of dollar value to total net log scale have been plotted for each 1-inch diameter interval to show the variation that exists in a log grade.

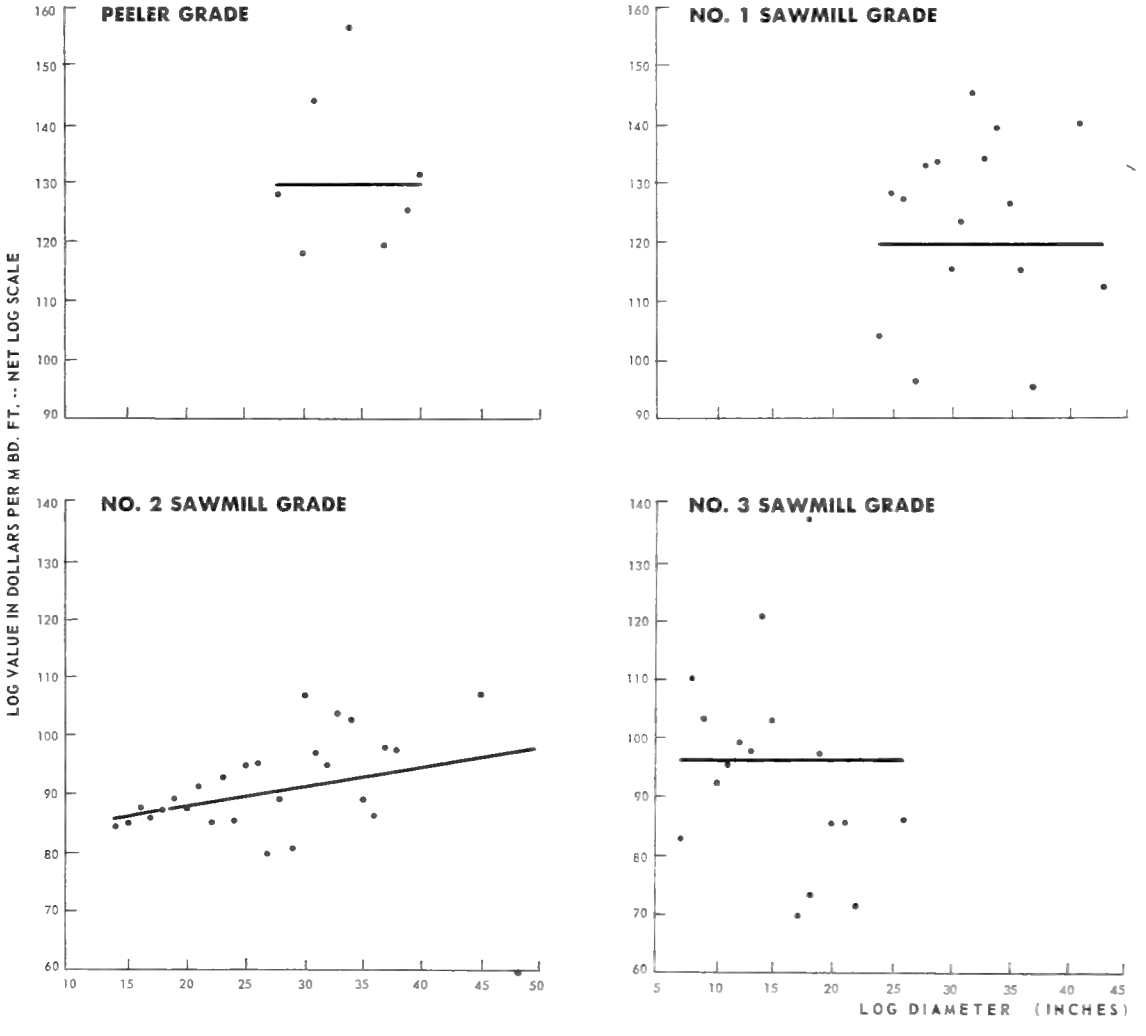

Figure 8.--Relationship of log value (dollars per thousand board feet, net log scale) to diameter by log grade (Official Log Scaling and Grading Rules).

Variation in Overrun

No general overrun is included in this west-side scaling system, since the curves of net log scale include the overrun. The variation in overrun by diameter is evident, however, in the differences between the curves of lumber value and log value. For instance, in the smaller diameters in log grade 2 the increase in value is considerable. An increase of about $26 per thousand board feet is found at the 15-inch diameter class in log grade 2. This increase in value is only $14 at the 30-inch diameter class. Generally speaking, high overrun is associated with small diameters; low overrun, or no overrun, with large diameters.

Overrun also may be influenced by the amount of scaled defect in logs, if some of the scaled defect is included in the lumber output. In this case the average lumber value is decreased, but the overrun is increased. If, on the other hand, the lumber output does not include scaled defect from the log, the average lumber value should be higher but the overrun should be lower. Because log value, per thousand board feet, net log scale, considers both average lumber value and overrun, the end result should be about the same in either case.

Relationship of Scaled Defect to Log Diameter

The relationship of defect to log diameter, for all log grades combined, is shown in figure 9. The percent of scaled defect increases with increasing diameters up to about 42 inches; there it levels off and begins a downward trend. Plotting the percent of defect over 1-inch diameter intervals shows the variation that exists between log groups. This variation is considerable, even in the smaller diameters where the amount of defect is small. This curved relationship may be used to estimate defect in Shasta red fir logs.

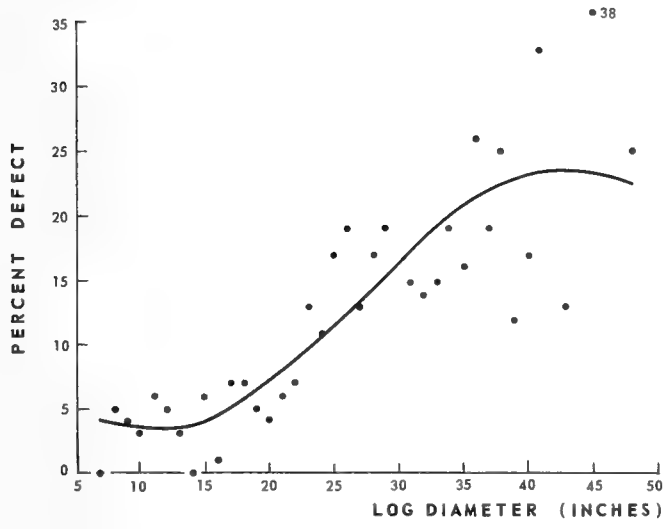

Figure 9.--Relationship of scaled defect percent to log diameter; all log grades combined (Official Log Scaling and Grading Rules).

APPENDIX

Trial Log Grades for Associated Species[7/]

Grade 1:

Minimum diameter, 18 inches.
Minimum length, 12 feet.
Surface-clear area: 12 feet of length in logs shorter than 16 feet, 75 percent of area in logs 16 feet or longer (three clear faces or 12 feet of clear length).
Exception: Two pin knots allowable on surface-clear portions.
Nonclear faces may have any number of knots of any size.

Grade 2:

Minimum diameter, 14 inches.
Minimum length, 12 feet.
Surface characteristics:
a. Logs 20 inches or more--
One clear face, and one face with live or dead knots and indicators not over 1 inch in diameter.
b. Logs 17-19 inches--
Two clear faces with one pin knot allowable on one of the clear faces.
c. Logs 14 to 16 inches--
Three clear faces. No pin knots allowed on clear faces.
Nonclear faces may have any number of knots of any size, except as noted.

Grade 3:

Minimum diameter, 12 inches.
Minimum length, 12 feet.
Surface characteristics:
Any number small knots allowable, but only one knot larger than one-sixth the log diameter permissible.
When a knot larger than one-sixth the log diameter occurs in a knot cluster, a decision must be made as to whether scale or grade of the log will be affected. For such logs, the following rules will apply--
a. Knot clusters or burls not eliminated in the slab require a scaling deduction and shall not be considered in grading logs of associated species.

7/ Taken from Log Grade Studies in the Ponderosa Pine Region, State of Oregon, Forest Products Research Center, Corvallis, pages 4 and 5.

b. Knot clusters not large enough to require a scaling deduction shall be treated as though the large knot in the cluster were a single knot--surrounding adventitious limbs or knots shall be disregarded.

Grade 4:

Any saw log that is not grade 1, 2, or 3 is grade 4.

Definitions:

A face is one-quarter the log circumference for full length of the log.
A clear face is one with no knots or knot indicators.
A pin knot is a knot up to 1/2 inch in diameter.

Table 8.--Surfaced dry lumber grade recovery from grade 1 Shasta red fir sawmill logs, by 1-inch diameter intervals, east-side practice, southern Oregon study, 1960[1/]

Log diameter (inches)	Number of logs	Lumber grade													Total lumber tally
		C	D	Molding	Factory Select	No. 1 Shop	No. 2 Shop	No. 3 Shop	Select Merchantable	Construction	Standard	Utility	Economy	Shop Outs	
		Percent of total recovery													Bd. ft.
19	1	7.6	4.3	25.2	0	0.6	7.0	5.1	1.3	3.7	7.4	17.1	20.2	0.5	111
20	2	1.4	4.5	5.9	0.7	1.8	8.0	12.5	5.7	7.7	10.3	20.8	18.4	2.3	389
21	3	11.6	5.3	34.4	0	.9	9.8	8.7	1.3	2.9	5.0	10.7	8.0	1.4	810
22	6	9.2	4.6	17.1	.2	1.1	8.6	9.0	2.2	5.2	8.8	17.1	16.5	.4	2,001
23	4	13.3	7.8	22.3	1.9	3.0	8.6	6.9	1.4	3.2	5.0	11.2	13.9	1.5	1,349
24	4	6.7	3.9	26.0	0	.8	8.1	6.9	3.3	6.6	8.2	13.9	14.9	.7	1,488
25	2	18.6	3.5	19.8	0	.5	5.0	4.0	4.6	8.4	9.8	14.5	11.0	.3	942
26	6	14.7	6.0	27.5	.2	1.0	7.7	5.6	2.8	5.4	6.5	10.7	11.4	.5	2,800
27	5	10.6	1.9	18.3	.1	1.3	10.0	11.0	2.6	5.3	7.1	14.4	16.7	.7	2,901
28	7	13.1	6.1	34.0	0	.9	9.5	7.7	1.4	3.0	4.5	9.6	9.3	.9	4,338
29	4	12.5	4.6	32.6	.1	1.0	10.4	9.0	3.0	5.0	5.4	8.0	7.7	.7	2,342
30	3	5.0	3.4	30.2	.1	.9	9.7	7.8	4.4	7.9	8.4	11.6	10.0	.6	2,118
31	5	11.9	6.0	34.6	.9	2.6	12.7	9.4	1.2	2.5	3.7	7.3	6.3	.9	3,376
32	7	19.2	5.1	33.4	0	.9	9.0	7.4	1.6	3.0	4.2	8.2	7.2	.8	4,992
33	3	9.9	5.9	29.3	.1	1.8	11.7	9.1	1.8	3.5	5.5	11.0	9.8	.6	2,413
34	5	16.1	4.2	30.3	.4	1.5	9.3	6.7	1.9	3.7	4.8	9.4	11.1	.6	4,085
35	5	15.1	5.1	34.5	.1	1.1	10.1	7.5	1.4	3.0	4.4	8.5	8.6	.6	4,117
36	3	11.2	2.8	20.8	.9	2.9	11.5	9.8	3.2	6.0	7.4	12.0	10.4	1.1	2,221
37	4	14.3	3.8	27.2	1.8	3.2	11.6	9.5	1.7	3.7	5.1	8.3	8.6	1.2	3,876
38	4	14.5	4.6	37.8	.1	1.0	10.6	8.2	1.7	3.3	4.0	6.8	6.6	.8	3,883
39	4	17.7	5.6	22.0	.7	1.6	7.2	6.4	3.8	6.3	7.0	10.8	9.9	1.0	3,852
40	4	14.6	5.6	28.9	0	.8	7.9	6.1	2.8	5.0	6.4	11.2	10.2	.5	5,028
41	1	18.1	4.2	39.9	.1	1.1	10.9	8.2	1.3	2.5	2.9	4.7	5.4	.7	1,090
43	2	12.7	5.1	39.6	.4	1.7	13.2	10.5	1.6	2.8	2.7	4.3	4.6	.8	2,546
46	1	6.0	4.2	19.4	.2	2.5	13.9	13.0	3.6	6.6	7.3	11.3	11.5	.5	1,497

1/ Trial Log Grades for Associated Species; maximum scaling length, 16 feet.

Table 9.--Surfaced dry lumber grade recovery from grade 2 Shasta red fir sawmill logs, by 1-inch diameter intervals, east-side practice, southern Oregon study, 1960[1/]

Log diameter (inches)	Number of logs	Lumber grade													Total lumber tally
		C	D	Molding	Factory Select	No. 1 Shop	No. 2 Shop	No. 3 Shop	Select Merchantable	Construction	Standard	Utility	Economy	Shop Outs	
		Percent of total recovery													Bd. ft.
15	2	0.5	1.2	13.7	0	0.4	4.1	3.1	6.4	12.7	16.1	24.3	17.2	0.3	214
16	3	8.4	2.5	13.6	0.3	2.2	9.4	7.6	5.4	9.5	11.9	17.7	11.1	.4	516
17	2	.9	3.0	11.1	.7	1.6	6.2	9.6	3.8	6.7	10.9	24.4	18.0	3.1	360
18	6	6.8	4.8	14.8	.2	.7	4.4	3.7	4.7	9.1	12.8	20.9	16.5	.6	1,340
19	5	3.1	1.7	11.5	0	.5	4.9	6.4	6.3	12.0	14.9	21.8	15.9	1.0	1,481
20	1	28.3	5.9	15.3	0	.3	2.2	1.4	6.4	9.5	9.9	12.0	8.8	0	217
21	13	5.8	3.3	12.6	.2	.7	5.2	5.6	7.2	12.1	13.6	19.2	13.9	.6	4,573
22	5	13.8	4.6	16.5	0	.5	4.4	3.6	6.0	10.0	11.2	16.2	13.0	.2	1,682
23	2	3.6	6.7	12.9	0	.4	4.0	3.1	5.3	10.0	12.4	22.2	19.2	.2	932
24	1	3.5	4.1	15.0	.1	1.5	9.0	10.5	6.2	9.5	10.4	15.7	12.9	1.6	560
25	5	1.7	1.9	17.0	.4	1.8	10.7	13.1	3.3	7.1	9.8	15.9	15.2	2.1	2,111
26	3	3.1	1.8	18.6	.1	1.9	11.0	10.7	3.9	8.0	11.1	16.6	12.2	1.0	1,573
27	1	15.9	6.9	23.2	0	.6	5.6	3.8	5.3	9.2	8.7	10.8	9.7	.3	520
28	10	6.7	3.9	21.1	.1	1.0	8.4	8.1	4.2	7.8	9.3	14.9	13.9	.6	6,095
29	2	14.1	2.2	19.6	.1	.9	8.5	9.3	4.7	8.4	8.9	11.9	10.9	.5	1,469
30	3	16.8	4.2	29.1	.1	.9	8.4	6.8	1.8	3.5	4.6	10.2	13.1	.5	1,975
31	5	7.8	2.7	21.0	.1	1.6	11.3	11.3	3.6	6.6	8.0	13.1	12.2	.7	3,612
33	2	18.5	3.4	20.4	.1	1.8	10.4	9.8	4.0	6.8	6.3	8.7	9.3	.5	1,755
35	2	8.8	3.8	23.1	0	.8	8.1	7.3	3.8	7.8	9.9	14.4	11.7	.5	1,821
37	3	9.1	3.3	22.3	.1	.8	7.5	6.5	5.1	9.1	9.6	14.0	12.1	.5	3,297
38	1	3.2	1.1	11.8	0	.8	4.7	4.0	9.7	16.8	15.4	17.4	14.6	.5	1,015
40	1	7.8	2.5	21.4	.1	1.2	9.6	9.6	5.4	9.3	9.1	12.5	10.7	.8	1,031

[1/] Trial Log Grades for Associated Species; maximum scaling length, 16 feet.

Table 10.--Surfaced dry lumber grade recovery from grade 3 Shasta red fir sawmill logs, by 1-inch diameter intervals, east-side practice, southern Oregon study, 1960[1/]

Log diameter (inches)	Number of logs	Lumber grade													Total lumber tally
		C	D	Molding	Factory Select	No. 1 Shop	No. 2 Shop	No. 3 Shop	Select Merchantable	Construction	Standard	Utility	Economy	Shop Outs	
		Percent of total recovery													Bd. ft.
12	24	1.4	0.7	3.9	0	0.2	1.4	1.1	11.0	19.6	20.0	23.3	17.3	0.1	2,802
13	37	.7	.7	1.8	0	0	.4	.6	12.0	21.0	21.6	24.0	17.1	.1	4,781
14	27	.5	.8	2.4	0	.1	.6	.8	10.3	19.2	21.1	26.1	17.9	.2	3,912
15	33	.9	.8	3.0	0	.1	1.1	1.1	10.5	19.2	20.5	24.9	17.8	.1	5,981
16	30	.7	.7	3.8	0	.2	1.7	2.1	9.5	18.0	21.1	25.1	16.9	.2	6,571
17	29	1.2	1.6	4.2	0.2	.4	2.4	3.2	10.1	17.7	18.9	23.2	16.4	.5	6,573
18	29	1.4	.5	3.5	.1	.4	2.3	2.9	10.4	18.1	19.6	23.4	16.9	.5	7,750
19	31	2.7	1.1	4.4	.2	.7	3.3	4.2	9.6	16.3	17.9	22.3	16.8	.5	9,310
20	21	2.0	1.3	7.3	0	.5	4.1	5.6	9.2	15.3	17.0	21.1	15.8	.8	6,832
21	15	1.7	1.6	6.5	.3	1.1	6.2	7.5	8.1	13.6	15.0	20.9	16.8	.7	5,211
22	16	.9	1.8	7.8	.2	.9	6.3	7.9	6.7	12.6	15.1	21.6	17.6	.6	6,173
23	9	3.2	1.5	10.7	.2	1.9	11.6	13.8	6.0	10.9	11.9	15.2	12.2	.9	3,337
24	13	3.9	2.5	10.6	.2	1.8	10.7	12.6	4.6	8.8	10.6	16.8	16.0	.9	5,246
25	7	1.3	1.2	8.1	.2	1.5	12.5	17.2	4.7	8.5	10.5	17.6	15.9	.8	3,426
26	10	2.0	3.5	14.2	.1	1.6	9.4	9.3	4.7	9.1	11.5	18.4	15.4	.8	5,043
27	8	3.3	1.5	8.4	.2	2.2	11.5	14.8	4.7	8.8	9.7	16.0	17.1	1.8	4,223
28	6	5.6	3.8	13.6	.1	1.9	10.7	11.3	5.4	9.4	10.1	14.2	13.1	.8	3,699
29	4	4.8	3.1	17.7	.1	.9	9.1	10.0	3.8	7.2	9.1	17.3	16.4	.5	2,359
30	3	3.0	1.4	8.8	.1	1.7	12.8	16.6	4.2	8.1	10.7	17.7	14.2	.7	2,051
31	5	2.7	1.7	15.2	.2	2.7	13.5	13.1	4.6	9.0	10.4	13.9	12.1	.9	3,768
32	3	1.3	.7	3.1	.5	3.6	17.2	23.5	1.9	4.4	7.6	16.7	17.1	2.4	1,847
33	3	3.5	1.6	11.2	.1	1.3	9.2	10.6	4.9	9.6	11.7	19.1	16.8	.4	2,647
34	1	10.8	5.3	33.0	.1	1.5	11.9	9.9	2.3	4.6	5.7	8.5	5.7	.7	733
35	5	5.9	2.8	21.1	.4	2.0	10.5	8.9	4.5	8.3	9.0	13.2	12.7	.7	4,658
36	2	3.3	3.3	17.5	.1	1.1	7.5	6.0	5.9	11.0	12.3	17.5	14.1	.4	1,809
37	1	1.1	.9	10.0	.1	1.2	7.5	10.7	3.4	8.0	13.2	23.7	18.1	2.1	852
45	1	4.2	2.6	26.8	.1	1.9	14.9	16.7	2.3	4.7	6.3	10.1	7.8	1.6	940
48	1	.3	.4	3.5	0	.1	1.6	1.7	5.3	11.6	16.6	29.8	29.0	.1	1,490

1/ Trial Log Grades for Associated Species; maximum scaling length, 16 feet.

Table 11.--Surfaced dry lumber grade recovery from grade 4 Shasta red fir sawmill logs, by 1-inch diameter intervals, east-side practice, southern Oregon study, 1960[1/]

Log diameter (inches)	Number of logs	Lumber grade													Total lumber tally
		C	D	Molding	Factory Select	No. 1 Shop	No. 2 Shop	No. 3 Shop	Select Merchantable	Construction	Standard	Utility	Economy	Shop Outs	
		Percent of total recovery													Bd. ft.
7	3	0.3	0.2	0.7	0	0	0	0	9.8	18.8	21.5	28.1	20.6	0	96
8	7	.4	.2	.7	0	0	0	0	9.9	18.3	20.4	29.1	21.0	0	327
9	18	.4	.3	1.9	0	0	0.4	0.3	10.2	19.1	21.9	26.8	18.7	0	1,097
10	28	.4	.5	2.1	0	0.1	.6	.8	9.8	18.5	21.7	27.1	18.2	0.2	2,146
11	30	1.1	.4	2.5	0	.1	.8	.7	9.9	17.4	19.9	26.9	20.2	.1	2,951
12	5	.2	.3	.6	0	0	0	0	6.6	16.5	24.7	31.1	20.0	0	537
13	3	.3	.2	.6	0	0	0	0	8.1	16.7	21.4	30.7	22.0	0	420
14	3	.3	.2	.6	0	0	.1	1.0	8.1	17.3	23.2	27.7	21.0	.5	575
15	3	.3	.3	.6	0	0	0	0	7.1	16.1	23.1	32.6	19.9	0	458
16	4	.3	.3	1.3	0	.3	1.4	2.8	7.8	17.6	23.7	27.5	16.2	.8	821
17	3	.2	.2	.5	0	0	.3	2.5	5.5	13.2	20.7	32.2	23.6	1.1	510
18	5	.2	.2	.5	0.1	1.0	5.9	8.8	6.3	13.5	18.1	25.7	18.9	.8	1,221
19	1	.2	.3	1.8	.1	1.0	6.9	14.0	3.4	9.5	16.4	24.8	18.7	2.9	354
20	2	.3	.6	6.6	.1	.9	9.4	19.9	5.5	11.1	13.3	16.4	11.7	4.2	523
21	3	.8	.6	1.0	1.1	2.8	10.0	15.8	4.5	9.0	11.7	20.1	19.6	3.0	1,017
22	2	1.2	.2	.8	.1	1.9	12.4	16.8	5.4	10.8	13.5	20.4	16.1	.4	814
23	1	.2	.1	.4	.2	2.6	16.1	29.9	5.7	9.7	9.1	11.9	8.8	5.3	285
24	1	.3	.2	.7	0	.1	1.3	2.1	8.8	16.3	18.5	28.8	22.8	.1	336
26	1	.2	.4	3.8	.1	1.3	13.0	19.2	2.2	6.6	12.6	21.7	18.4	.5	246
28	1	.2	.3	3.2	.3	4.2	20.2	24.9	2.0	5.5	10.1	16.8	10.7	1.6	529

[1/] Trial Log Grades for Associated Species; maximum scaling length, 16 feet.

Table 12.--Surfaced dry lumber grade recovery from Shasta red fir Peeler logs, by 1-inch diameter intervals, west-side practice, southern Oregon study, 1960[1/]

Log diameter (inches)	Number of logs	Lumber grade													Total lumber tally
		C	D	Molding	Factory Select	No. 1 Shop	No. 2 Shop	No. 3 Shop	Select Merchantable	Construction	Standard	Utility	Economy	Shop Outs	
		Percent of total recovery													Bd. ft.
28	2	13.2	6.3	42.9	0.1	1.2	12.1	9.0	0.7	1.6	2.4	4.8	4.9	0.8	1,792
30	2	15.9	4.6	31.9	0	.8	8.5	6.3	2.7	5.1	6.1	9.8	7.8	.5	2,793
31	1	12.0	6.1	40.8	.1	1.1	11.6	8.6	1.1	2.3	3.2	6.3	6.1	.7	1,804
34	1	18.6	5.7	39.7	.1	1.1	10.9	8.9	.7	1.5	1.9	4.3	5.6	1.0	1,840
37	1	20.7	5.1	25.7	3.3	5.0	11.9	9.7	.9	1.4	1.7	4.6	7.7	2.3	1,894
39	1	21.8	6.4	28.8	0	.7	7.0	5.0	3.8	6.5	6.2	7.2	6.2	.4	2,315
40	1	14.2	5.1	40.4	.3	1.5	12.7	10.1	2.1	3.1	2.8	3.5	3.4	.8	2,730

1/ Bureau log grades for hemlock; maximum scaling length, 40 feet.

Table 13.--Surfaced dry lumber grade recovery from grade 1 Shasta red fir sawmill logs, by 1-inch diameter intervals, west-side practice, southern Oregon study, 1960[1/]

Log diameter (inches)	Number of logs	Lumber grade													Total lumber tally
		C	D	Molding	Factory Select	No. 1 Shop	No. 2 Shop	No. 3 Shop	Select Merchantable	Construction	Standard	Utility	Economy	Shop Outs	
		Percent of total recovery													Bd. ft.
24	2	7.6	4.5	24.7	0.1	1.2	8.9	6.8	5.1	9.2	9.2	11.7	10.5	0.5	1,784
25	2	15.3	4.2	27.5	.1	1.1	9.0	7.7	2.2	4.4	6.1	10.9	10.7	.8	2,231
26	3	12.2	4.6	32.5	.1	1.2	10.8	9.2	2.2	4.4	5.3	8.2	8.5	.8	3,033
27	4	8.9	4.8	19.3	.8	2.1	10.1	9.6	3.5	6.5	8.1	13.4	12.1	.8	4,748
28	3	13.1	4.3	33.0	.1	1.1	10.5	8.8	2.6	4.9	5.4	8.0	7.6	.6	4,371
29	1	9.7	4.5	35.2	.1	1.1	11.6	9.8	1.9	3.5	4.2	8.4	9.3	.7	1,425
30	3	17.0	4.3	31.4	0	.9	8.9	7.7	1.4	2.8	4.1	9.3	11.3	.9	3,275
31	1	7.8	4.1	37.7	.1	1.4	13.0	10.8	2.2	4.0	4.4	6.7	7.0	.8	1,628
32	1	18.2	5.8	26.0	0	.7	6.4	4.6	3.8	6.6	7.1	10.9	9.5	.4	1,674
33	2	18.4	5.3	30.9	.1	1.9	12.1	9.7	1.9	3.2	3.8	6.5	5.6	.6	3,824
34	1	19.8	5.3	32.5	1.3	2.4	10.5	8.1	.3	1.0	2.5	7.1	8.0	1.2	1,512
35	2	17.9	3.6	27.1	.1	1.1	8.2	6.3	2.9	5.5	6.6	10.5	9.7	.5	3,496
36	2	10.3	3.3	17.7	1.6	3.4	10.5	8.3	3.1	5.6	7.5	14.1	13.5	1.1	3,001
37	2	6.8	3.8	25.7	.1	.9	9.8	9.5	3.1	6.4	8.3	13.1	11.8	.7	4,070
41	1	18.1	4.2	39.9	.1	1.1	10.9	8.2	1.3	2.5	2.9	4.7	5.4	.7	1,090
43	1	15.1	6.2	32.9	.1	1.3	10.4	7.9	2.7	4.7	4.5	6.8	6.8	.6	1,216

1/ Bureau log grades for hemlock; maximum scaling length, 40 feet.

Table 14.--Surfaced dry lumber grade recovery from grade 2 Shasta red fir sawmill logs, by 1-inch diameter intervals, west-side practice, southern Oregon study, 1960[1/]

Log diameter (inches)	Number of logs	Lumber grade													Total lumber tally
		C	D	Molding	Factory Select	No. 1 Shop	No. 2 Shop	No. 3 Shop	Select Merchantable	Construction	Standard	Utility	Economy	Shop Outs	
		Percent of total recovery													Bd. ft.
14	18	0.9	0.7	2.4	0.1	0.3	1.5	2.2	9.7	18.5	21.5	25.6	16.2	0.4	5,818
15	17	1.2	1.2	5.0	0	.3	2.5	2.8	10.6	18.8	19.3	22.5	15.5	.3	6,292
16	18	2.2	1.4	6.9	0	.4	2.7	2.5	9.2	17.0	19.4	22.7	15.4	.2	7,458
17	15	2.5	2.1	5.1	.4	.8	3.1	4.1	9.4	15.8	17.6	22.3	16.0	.8	7,355
18	21	2.7	1.3	5.8	.1	.5	3.5	4.5	10.0	16.2	17.2	21.3	16.4	.5	11,640
19	16	3.5	1.6	8.8	.1	.7	4.8	5.3	8.3	14.0	15.8	20.7	15.9	.5	10,281
20	13	4.5	2.5	11.8	.2	1.1	7.9	9.8	5.5	10.6	12.8	18.2	14.1	1.0	8,569
21	11	7.5	3.5	16.0	.2	1.0	6.9	7.0	5.3	9.5	11.2	16.8	14.4	.7	7,761
22	10	4.0	2.6	10.1	.3	1.0	7.3	9.5	6.7	11.7	13.0	18.2	14.8	.8	7,526
23	6	4.8	4.3	17.0	.4	1.7	8.9	8.0	4.3	8.2	9.8	16.2	15.8	.6	5,313
24	7	3.9	1.6	9.1	.3	2.3	12.6	15.6	3.5	7.0	9.4	16.8	16.6	1.3	5,595
25	5	4.4	4.1	12.8	.2	1.2	8.7	10.5	4.3	8.4	10.7	17.6	16.2	.9	5,408
26	7	6.9	3.7	18.1	.1	1.4	8.8	8.0	4.1	8.0	10.3	16.7	13.2	.7	6,606
27	4	2.9	2.1	10.5	.1	1.6	11.9	15.3	5.7	10.4	10.9	15.0	12.8	.8	3,972
28	5	3.1	2.1	15.8	.2	2.7	13.4	13.0	4.7	8.5	9.4	13.9	12.3	.9	6,420
29	3	4.2	2.0	17.0	.1	1.2	10.2	11.3	3.3	6.4	9.0	17.2	17.4	.7	3,062
30	2	11.8	3.7	18.6	.1	1.4	10.1	10.7	2.2	4.5	7.3	15.2	13.8	.6	2,619
31	3	4.1	2.6	18.8	.1	1.1	8.5	8.0	4.4	8.9	11.1	16.7	15.1	.6	4,989
32	4	4.9	2.2	13.7	.2	1.6	10.3	11.8	4.5	8.5	9.9	16.0	15.4	1.0	6,648
33	2	8.3	3.1	23.6	.1	1.8	11.8	11.0	3.1	6.1	7.5	11.9	10.9	.8	3,270
34	1	11.3	5.0	27.5	.1	1.0	8.6	6.7	3.1	6.1	7.7	12.3	10.1	.5	1,766
35	1	5.4	2.6	15.4	1.0	3.7	14.0	11.7	3.6	7.0	8.5	13.5	13.0	.6	1,622
36	1	4.8	2.7	17.9	0	.7	6.0	4.7	6.8	12.4	12.9	17.2	13.6	.3	1,965
37	2	8.1	3.4	20.9	0	.7	6.7	6.2	3.7	7.5	10.1	17.4	14.6	.7	4,545
38	1	5.5	1.8	16.7	.1	1.0	7.1	6.8	7.5	13.1	12.2	15.0	12.6	.6	2,046
45	1	5.3	3.6	22.2	.2	2.3	14.3	14.3	3.1	5.9	6.9	10.8	10.1	1.0	2,437
48	1	.3	.4	3.5	0	.1	1.6	1.7	5.3	11.6	16.6	29.8	29.0	.1	1,490

1/ Bureau log grades for hemlock; maximum scaling length, 40 feet.

Table 15.--Surfaced dry lumber grade recovery from grade 3 Shasta red fir sawmill logs, by 1-inch diameter intervals, west-side practice, southern Oregon study, 1960[1/]

Log diameter (inches)	Number of logs	Lumber grade													Total lumber tally
		C	D	Molding	Factory Select	No. 1 Shop	No. 2 Shop	No. 3 Shop	Select Merchantable	Construction	Standard	Utility	Economy	Shop Outs	
		Percent of total recovery													Bd. ft.
7	4	0.3	0.2	0.6	0	0	0	0	7.7	16.3	22.1	32.1	20.7	0	376
8	8	1.2	.7	1.4	0	0	0.1	0	12.0	20.3	19.5	25.5	19.3	0	818
9	18	1.3	.4	3.0	0	0.2	.9	0.9	9.0	17.2	20.6	26.4	20.0	0.1	2,795
10	17	.4	.3	1.7	0	.1	.6	.8	10.8	19.8	21.6	25.7	18.1	.1	3,013
11	17	.5	.5	2.1	0	0	.5	.4	11.1	19.4	21.5	26.2	17.8	0	3,318
12	16	.9	.9	3.3	0	.1	1.0	.8	10.1	18.3	19.8	25.8	18.9	.1	3,685
13	25	.8	.7	3.0	0	.2	1.3	1.6	9.8	18.1	20.2	25.2	18.8	.3	7,650
14	1	.3	.4	3.0	0.1	.8	2.8	2.0	7.5	17.9	25.2	25.8	14.1	.1	534
15	4	.3	.5	4.3	0	.3	3.5	7.3	5.6	12.2	17.1	26.3	20.9	1.7	1,456
17	3	.2	.2	.5	0	.5	3.6	9.2	5.1	11.0	15.9	27.7	23.6	2.5	839
18	5	.5	.2	.9	.2	1.1	5.5	10.3	5.5	11.9	16.2	25.0	20.6	2.1	1,603
19	3	.3	.7	1.4	.1	.7	4.5	6.7	5.2	11.8	17.4	27.7	22.9	.6	1,896
20	1	.4	1.0	11.1	.1	1.9	9.7	10.4	6.2	12.9	15.7	17.7	11.7	1.2	698
21	1	1.8	.3	1.0	.2	2.3	12.6	15.8	7.5	14.0	14.9	17.8	11.4	.4	512
22	2	.1	.1	.5	.1	1.2	10.3	17.4	2.4	5.0	8.0	22.6	30.7	1.6	1,355
23	1	4.2	1.2	11.6	0	.8	5.8	7.2	2.7	6.7	11.8	24.3	22.5	1.2	884
26	1	.1	.1	.3	.3	3.4	17.6	31.8	2.0	4.5	6.5	12.7	14.4	6.3	548

[1/] Bureau log grades for hemlock; maximum scaling length, 40 feet.

Table 16.--Surfaced dry lumber prices used in calculating lumber values for Shasta red fir[1/]

Lumber grades		Price per M b.m.	
Developed in study	Volumes in board feet	From WPA summary	Used in study
5/4 and Thicker C and Better	--	$158.63	$158.63
5/4 and Thicker D	--	133.12	133.12
5/4 and Thicker Molding	--	130.00	130.00
5/4 and Thicker Factory Select	--	121.42	121.42
5/4 and Thicker No. 1 Shop	--	109.77	109.77
5/4 and Thicker No. 2 Shop	--	78.88	78.88
5/4 and Thicker No. 3 Shop	--	59.00	59.00
5/4 and Thicker Shop Outs	--	46.45	46.45
4/4 Select Merchantable	429	87.58	--
8/4 Select Merchantable	6,072	67.72	[2/] 69.50
4/4 Construction	5,184	87.58	--
8/4 Construction	50,787	67.72	--
4/4 Standard	2,000	60.80	--
8/4 Standard	28,121	67.72	67.26
4/4 Utility	3,149	49.03	--
8/4 Utility	29,105	45.55	45.89
4/4 Economy	1,673	33.28	--
8/4 Economy	20,097	23.27	24.04

[1/] From Western Pine Association's 1960 price summary for white fir, which includes Shasta red fir.

[2/] Weighted by lumber volumes in study.

Grantham, John B., and Hunt, Douglas L.
1963. Lumber yield and log values of Shasta red fir. Pac. NW. Forest & Range Expt. Sta. U.S. Forest Serv. Res. Paper PNW-2, 30 pp., illus.

Lumber grade yield from representative Shasta red fir of southern Oregon was determined in cooperation with industry and other public agencies. Lumber yields and log values--computed by applying 1960 industry prices to these yields--are tabulated by log diameter and log grade in accordance with grading and scaling practices used both east and west of the Cascade Range. Results of the study indicate relative yields and log values of either Shasta or California red fir growing in southern Oregon.

Grantham, John B., and Hunt, Douglas L.
1963. Lumber yield and log values of Shasta red fir. Pac. NW. Forest & Range Expt. Sta. U.S. Forest Serv. Res. Paper PNW-2, 30 pp., illus.

Lumber grade yield from representative Shasta red fir of southern Oregon was determined in cooperation with industry and other public agencies. Lumber yields and log values--computed by applying 1960 industry prices to these yields--are tabulated by log diameter and log grade in accordance with grading and scaling practices used both east and west of the Cascade Range. Results of the study indicate relative yields and log values of either Shasta or California red fir growing in southern Oregon.

Grantham, John B., and Hunt, Douglas L.
1963. Lumber yield and log values of Shasta red fir. Pac. NW. Forest & Range Expt. Sta. U.S. Forest Serv. Res. Paper PNW-2, 30 pp., illus.

Lumber grade yield from representative Shasta red fir of southern Oregon was determined in cooperation with industry and other public agencies. Lumber yields and log values--computed by applying 1960 industry prices to these yields--are tabulated by log diameter and log grade in accordance with grading and scaling practices used both east and west of the Cascade Range. Results of the study indicate relative yields and log values of either Shasta or California red fir growing in southern Oregon.

Grantham, John B., and Hunt, Douglas L.
1963. Lumber yield and log values of Shasta red fir. Pac. NW. Forest & Range Expt. Sta. U.S. Forest Serv. Res. Paper PNW-2, 30 pp., illus.

Lumber grade yield from representative Shasta red fir of southern Oregon was determined in cooperation with industry and other public agencies. Lumber yields and log values--computed by applying 1960 industry prices to these yields--are tabulated by log diameter and log grade in accordance with grading and scaling practices used both east and west of the Cascade Range. Results of the study indicate relative yields and log values of either Shasta or California red fir growing in southern Oregon.